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**United States Patent** [19]

Oshima et al.

[11] **Patent Number:** 5,600,672[45] **Date of Patent:** Feb. 4, 1997[54] **COMMUNICATION SYSTEM**[75] **Inventors:** Mitsuaki Oshima, Kyoto; Seiji Sakashita, Osaka, both of Japan[73] **Assignee:** Matsushita Electric Industrial Co., Ltd., Osaka, Japan[21] **Appl. No.:** 240,521[22] **Filed:** May 10, 1994**Related U.S. Application Data**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.<sup>6</sup>** H04L 5/16; H04B 1/38[52] **U.S. Cl.** 375/219; 375/270; 375/301; 375/321[58] **Field of Search** 375/219, 259, 375/260, 261, 262, 265, 270, 240, 321, 326, 341, 354; 348/725, 726, 723, 724[56] **References Cited****U.S. PATENT DOCUMENTS**

5,164,963 11/1992 Lawrence et al. 375/265

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Shanmugam, "Digital and Analog Communication Systems" 1979, p. 272.

*Primary Examiner*—Stephen Chin*Assistant Examiner*—Hai H. Phan*Attorney, Agent, or Firm*—Wenderoth, Lind & Ponack[57] **ABSTRACT**

At the transmitter side, carrier waves are modulated according to an input signal for producing relevant signal points in a signal space diagram. The input signal is divided into, two, first and second, data streams. The signal points are divided into signal point groups to which data of the first data stream are assigned. Also, data of the second data stream are assigned to the signal points of each signal point group. A difference in the transmission error rate between first and second data streams is developed by shifting the signal points to other positions in the space diagram expressed at least in the polar coordinate system. At the receiver side, the first and/or second data streams can be reconstructed from a received signal. In TV broadcast service, a TV signal is divided by a transmitter into low and high frequency band components which are designated as first and second data streams respectively. Upon receiving the TV signal, a receiver can reproduce only the low frequency band component or both the low and high frequency band components, depending on its capability. Furthermore, a communication system based on an OFDM system is utilized for data transmission of a plurality of subchannels, wherein the subchannels are differentiated by changing the length of a guard time slot or a carrier wave interval of a symbol transmission time slot, or changing the transmission electric power of the carrier.

**12 Claims, 178 Drawing Sheets**